



Room for improvement – A study of overconfidence in numerical skills among British graduates

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Abstract

The experiment tested overconfidence in number skills among graduates and non-graduates. The data was collected at a residential management training programme for part-time professional students. Half had a degree and half did not. In the light of increasing research evidence about employers' dissatisfaction with graduates' basic skills, we set out to test whether graduate professionals overstated their numerical abilities compared to non-graduates. The experiment, conducted using E-prime, showed a significant interaction between level of qualification and overstatement of numerical abilities. The results support the hypotheses and showed that graduates rated themselves higher than actual abilities. Graduates' performance in the test was not consistent with their confidence estimates. The findings are significant for rethinking higher education curricula which are currently under pressure to align with the needs of the economy. We advocate more inclusive and interpretive research for greater understanding of the issues to offer useful policy data and help higher education institutions (HEIs) prepare graduates for an ever dynamic workplace and decision-making. However, few experiments have tested the numeracy level of graduates to corroborate the narrative coming from the employers. This study, despite the limited sample, is a first attempt and can be a reference for future wider studies.

Key words: overconfidence, graduates employability, numeracy, skills, manager development, higher education, universities

Introduction

Graduate employability has been high on both government and the higher education agendas for the past two decades in the UK and the developed world generally. There is more and more concern that while graduates acquire significant subject knowledge when they leave universities and colleges, an important proportion of them may lack basic skills. Some of the areas considered to be areas in which graduates lack skills centre on planning, information technology (IT), literacy and communication (Okolie, Nwosu, and Mlanga, 2019; Shultz, 2008; Raybould & Sheedy, 2005). Numeracy is a critical skill required if graduates were to typify other employer requirements such as project management, planning and ability to work with uncertainty (Tymon, 2013; Black and Yasukawa, 2010; Raybould & Sheedy, 2005). However, the Financial Times (2015) reports on an OECD study in the same year which shows that United States (US) and United Kingdom (UK) graduates are weaker on literacy and numeracy than their peers from other developed nations. Kuczera, Field & Windisch's (2016) study found that over 9 million adults in the UK have low basic skills, mainly in the areas of numeracy and literacy. Despite these figures, when graduates are interviewed they appear to display confidence that is at odds with the research evidence showing a different perspective taken by employers (Tymon, 2013). This may lead to view the attitudes and responses of the graduates as an expression of overconfidence.

Research on overconfidence has emerged as an important area in cognitive psychology (Bi et al., 2016; Anderson et al., 2012; Kennedy, Anderson, and Moore, 2013; Malmendier & Tate, 2004; Saunders, Nolan, and Provost, 2009). It is an area within the much-researched field of judgement and decision making which has fascinated and captivated the imagination of cognitive psychologists for a few decades now (Malmendier & Tate, 2004; Schulz & Thöni, 2016). Much of the literature on judgement and decision-making acknowledges that while we cannot necessarily teach people how to make decisions based on objective quantity (Ayton, in Braisby & Gellatly, 2005), it is important to understand people's own 'rationality' for choosing one solution over another. Psychological research in decision-making aims to bridge the gap between normative and

descriptive approaches to decision-making, i.e. help people make better decisions. Overconfidence can present difficulties for learning in the sense that it can operate as a barrier to recognising personal needs as was found in Anzalone's (2009) study among college learners in the USA.

The aim of the research is to assess the degree to which the expressed confidence of graduates in numerical skills is exemplified in their capabilities in practice. Overconfidence ('I think I can do it') is a cognitive bias, defined as an individual's tendency to overestimate ability and probability of gaining positive outcomes (Giacomin, Janssen & Shinnar, 2016). Overconfidence also occurs when individuals believe themselves to be better than others (Bell and Volckmann, 2011; Bi, Dang, Li, Guo, and Zhang, 2016; Mertins et al., 2015). As such, university graduates often overestimate their own ability, performance, control, or chances of success (Anderson et al., 2012; Bortolotti and Antrobus, 2015; Herz, Schunk & Zehnder, 2014; Johnson & Fowler, 2011). Linked to graduate employability concerns (Minocha, Hristov, and Reynolds, (2017), there is more and more concern that while graduates acquire significant subject knowledge when they leave universities and colleges, an important proportion of them may lack basic skills (Pitan, 2017).

The main question of the research was: 'To what extent do university graduates overestimate their abilities to deal with numbers due to higher level education experience?' The research pursues three objectives: (1) To assess graduates and non-graduates evaluation of their own skills in numeracy. A pre-test confidence rating question was to participants (see methods section); (2) To determine whether a higher level education (particularly completion of higher education) leads to overconfidence about number skills; (3) To test whether the level of overconfidence experiences variations with levels of difficulty of the numerical test questions. The research design developed three hypotheses: (a) Graduates are more likely than non-graduates to over-rate their basic mathematical skills and use graduate status to legitimise such a claim; (b) Graduates' real basic mathematical skills can be lower than their estimates of skills – the value and disadvantages of overconfidence are further discussed in the literature review; (c) In a basic number test, the performance of graduates is not higher than that their non-graduate counterparts.

To conceptualize overconfidence in numerical skills, this empirical research adopts Brunswik's (1955) theory of overconfidence. Gigerenzer, Hoffrage & Kleinbolting (1991) and Hammond (1965) outlined how this cognitive conflict could be construed within Brunswik's (1955) lens model framework, as well as the experimental methods that researchers could use to study the nature, source and resolution of the disagreement between parties performing judgment tasks. Using a simple test of confidence with numbers, the research attempts to establish whether graduates and non-graduates show the overconfidence effect (i.e. if the confident judgements about their mathematical abilities are larger than the average of right answers that they produce in a simple numerical test). The study seeks to establish whether the fact of possessing higher qualifications leads graduates to overestimate their basic mathematical skills compared to those who do not have a university degree. More importantly, we examine the implications of this, if it occurs.

Literature review

Conceptualizing Overconfidence

Existing research evidence shows that optimism and overconfidence are common among university students (Bi et al., 2016; Giacomini, Janssen, and Shinnar, 2016).

Studies of overconfidence have examined whether people know as much as they claim to and if some individuals think they can do it better than others (Bortolotti and Antrobus, 2015; Herz, Schunk, and Zehnder, 2014; Hmielecki and Baron, 2009; Mertins et al. 2015). Although, it depends on what, and whom you ask, overconfidence occurs when people rate themselves better than the median (Bi et al., 2016; Moore & Healy, 2008) or overestimate their own ability, performance, control, or chances of success (Bi et al., 2016; Johnson & Fowler, 2011). In other terms, these studies raise the question of whether people do not suffer from over inflation of self-value when rating their own knowledge of reality (Chiu & Klassen, 2010; Christensen-Szalanski & Bushyhead, 1981). For Harvey (1997) this means people's judgements and decisions are based on

their own estimates or probabilities that particular outcomes will materialise. Such estimates are quantified by cognitive psychologist researchers with rates between 0 - 100% (which are referred to as full-range tasks) or often between 50-100% (which are also referred to as half-range tasks).

Research using these rating scales found that, in general, when presented with two items and asked to choose the right answer and rate their level of confidence (or certainty) people tend to rate themselves higher than they could produce actual right answers. This is a bias that is, for Gigerenzer, Hoffrage & Kleinbolting (1991), a manifestation of overconfidence. Research in the field also claims that the harder the question the less overconfident people become. This proposition implies that people are more overconfident for simple (easy) questions and are more realistic with estimates about their knowledge of more difficult questions. Within the context of overconfidence research, this has been termed the Hard-Easy Effect (Brunswick, 1955).

Overconfidence and learning

The significance of the study of overconfidence in education is evidenced is a number of studies. For instance, Anzoline (2009) found that overconfidence could impair learning in students because it creates a false sense of knowledge which leads the learner to disengage with the learning process. Similar findings appear in Gustavson & Niall's (2011) study graduates' confidence in research skills. These authors found in their survey that students who rated their research skills as expert level scored only 50% in the research skills test, which is lower than the score of the students who rated themselves as only good.. Chiu & Klassen (2010: 3) posit that overconfidence (which they refer to as overestimation) of "one's potential performance or self-efficacy can lead to poor preparation and lower performance". Similar findings are reported by Ackerman & Wolman (2007). In the context of employment and organisations, namely in the financial sector, the negative consequences of overconfidence have been elaborated on by Menkhoffa, Schmidta & Brozynskiab (2006). They found that less experienced fund managers had higher returns than those who had longer length of service due to the latter developing overconfidence and complacency over the years while the former did not take anything for granted and therefore

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3 deployed greater diligence. De la Rosa et al.'s (2011) study about
4 "Overconfidence and moral hazard" yielded some very similar results, which
5 asserted that "an overconfident agent disproportionately values success-
6 contingent payments" (p. 429). This is consistent with Brunswick's (1955) 'hard-
7 easy effect' since familiar tasks in their experience are treated by the
8 experienced agent as 'easy' tasks that can be completed with minimum effort.
9 These studies demonstrated that overconfidence is an ill with far-reaching
10 negative consequences and is therefore worth tackling vigorously at personal
11 and institutional levels.
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20 The importance of overconfidence for managers and entrepreneurs has been
21 highlighted in many studies (Bi et al., 2016; Bortolotti & Antrobus, 2015;
22 Johnson & Fowler, 2011; Kennedy, Anderson & Moore, 2013; Giacomini,
23 Janssen, and Shinnar, 2016). Some studies focus on the mental advantages of
24 overconfidence, including increased motivation, higher goals, strengthened
25 coping mechanisms in the face of negative feedback (e.g., Bortolotti &
26 Antrobus, 2015), increased competitiveness (Johnson & Fowler, 2011).
27 Giacomini, Janssen & Shinnar, (2016) argues that both optimism and
28 overconfidence are beneficial when deciding to become an entrepreneur as
29 they "downplay uncertainty or setbacks and focus on what is good in a
30 situation", further pointing out that optimistic entrepreneurs are more likely to
31 pursue entrepreneurial activities and persist when faced with challenges.
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43 The overconfidence shown by students (Bi et al., 2016; Bell & Volckmann,
44 2011; Kennedy, Anderson & Moore, 2013) generally poses a problem for the
45 higher education system and employers because it blurs potential support
46 mechanisms to attain greater basic skills in graduates and improve their
47 employability. Black & Yasukawa (2010) found low levels of literacy and
48 numeracy among adults, including graduates. Yet, Durrani & Tariq (2012)
49 stress the significance of developing numerical skills in undergraduates,
50 pointing out that such skills have become core employability skills and essential
51 selection criteria in the modern labour markets and in the knowledge economy
52 (Browne 2010). A study by Saunders et al. (2009) on Australian undergraduate
53 students, also provide "evidence that suggests that poor performance (among
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students) might, in fact, be associated with overly optimistic attributions based on past successes" (p. 1). Given such critical findings with far reaching implications the need for sustained investigations into how greater numerical literacy could be developed by graduates is no longer argued. These findings are echoed by Hernández-Fernaud et al. (2017) and the Learning & Skills Council (LSC) (2006). Therefore, there have been calls from educationalists, policymakers and government departments, and universities to pay greater attention to generic skills (McLarty, 2005), communication skills (writing and speaking) and team working skills (Krassadaki, Lakiotaki, and Matsatsinis, 2014) and numeracy skills (Black and Yasukawa, 2010; Raybould & Sheedy, 2005).

Impact of overconfidence on employers/employment

Hillage and Pollard (1998) define employability not just in terms of being employed after graduation but also in terms of the graduate's ability to secure and hold on to a job in an increasingly competitive market place. Employability has often been defined from the employers' perspectives and the student views have been ignored (Tymon, 2013). While graduates view technical skills as pre-eminent for work, employers look at other transferable skills including basics skills and various personal qualities. However if employability interventions are to be targeted and effective, it is important to understand the recipients' standpoint. The dichotomy in the perception of employability is not just in terms of employers' and students' definitions; academics also have differences in articulating a consistent definition of employability (Tymon, 2013). Some academics emphasis skills (Poole & Sewell, 2007; Hillage & Pollard, 1998) while others take a broader perspective (Tymon, 2013; Yorke, 2004) by including personal attributes within the domain of employability; some other researchers consider employability as closely associated with education-employment trajectories as well as students' biographical trajectories which influence whether the students "gain or fail to gain employment outcomes" (Holmes, 2013). With millions of graduates exiting universities every year, the competitiveness of the aspiring professional is no longer established only with the classification of their degree, nor the subject studied. However, important extra-curricular activities and skills gained have become assets (Poole and

Sewell, 2007) that employers seek in a good graduate. While soft skills feature high on the requirements of modern employers, Pegg et al. (2012) and Black & Yasukawa (2010) found that numeracy is equally high on the employers' view of fundamental graduate assets. Pegg et al. (2012), in particular, found that since 2010 higher education institutions in England have been "required to articulate their position in relation to student employability through the provision of an 'employability statement'".

Adult basic skills particularly in numeracy and literacy have been the subject of debate in the UK for several decades. Kuczera, Field & Windisch (2016) found that in excess of 9 million adults in the UK lack numeracy. This figure includes a sizeable proportion of those completing university education. In fact, the OECD (2013), exposed the evidence that graduates' level of numeracy is below that of graduates from several competing nations of the developed world. This is a surprising finding since the OECD found in 2013 that the number of young people Not in Education, Employment or Training (NEET) has not changed in the current decade and is lower than that of a number of European Union countries. Faced with such apparent contradictions between reality and research findings, it is important to undertake further inclusive and interpretive research (Karadağ, 2017) which could be useful to policy makers and higher education establishment alike.

The merits and demerits associated with an overconfident attitude have been the subject of several studies (Bi et al., 2016; Hmieleski and Baron 2009). Higher Education (HE) stakeholders need to be concerned about overconfidence in numerical skills like over-qualifications of graduates required for vacant positions (Green & Zhu, 2010; Mavromaras & McGuinness, 2012) which is interpreted as a disadvantage (Nielsen, 2011), overconfidence lead graduates to overstate their abilities (Chiu & Klassen, 2010) at the recruitment stage, leading to performance issues once in post resulting in wage penalties (Mavromaras & McGuinness, 2012), underutilization of talent (Johnston et al., 2015), the pursuit of unreasonable goals (Bi, et al., 2016) and lower levels of job satisfaction (Green & Zhu, 2010). Overconfidence leads graduates to overstate their numerical abilities at the recruitment stage. Those who scrape

through still require significant employer support once employed, particularly in areas such as project management or budgeting.

There has been sustained research connecting employability skills, especially numeracy, with productivity (Jones et al., 2017; Álvarez-González, López-Miguens & Caballero, 2017; Tymon, 2013; Keep, Mayhew and Payne, 2006; Huselid, 1995). The Learning & Skills Council (LSC) which works with employers and communities to improve skills in England and Wales acknowledged that there are skills gaps in the UK. There is some consensus that investment in the development of basic skills is a pre-condition for steering and maintaining productivity (LSC, 2006; House of Commons, 2015; Kuczera, Field & Windisch (2016). Other studies advocate a link between employee creativity, organisation innovation and performance. For instance, supporting the skills-productivity link, Dedahanov, Rhee & Yoon (2017: 343) contend that “in dynamic marketplaces, innovativeness is necessary to create and sustain superior performance”. This is partly through the effectiveness of a numerate and skilled workforce. Studying graduate level of numeracy in particular and basic skills in general, is a significant step in attaining greater organisational performance and national productivity, benefitting all stakeholders. Huizinga et al. (2008) contend that numeracy does not have only economic or productivity consequences but also health issues. They established a correlation between low numeracy and obesity.

The role of higher education

Temple (2012) & Shaheen (2011) highlight the crucial role that higher education can play in skilling the nation and proposes a skills-based approach to the curriculum to effectively support economic growth. Temple (2012) contends that modern universities need to rise above the traditional teaching and research role, to locate their new position at the heart of regional development and regeneration. In approaching their new role, universities need to focus on graduate employability (Hernández-Fernaund, E. et al., 2017; Álvarez-González, López-Miguens & Caballero, 2017) and create graduates who can articulate basic skills, including numeracy and literacy. In the same perspective, Mason,

Williams and Cranmer (2009) found that numeracy is one of the greatest graduate employability assets. To develop such assets, the authors acknowledge the instrumentality of employer involvement in higher education curriculum design. From a utilitarian standpoint, employer involvement will render curricula relevant and will enable universities to demonstrate their embeddedness in society and the locality (Tymon, 2017). Increasing research evidence asserts the need for collaboration between HEIs and to deliver higher education that responds to the needs of contemporary organisations and economies (Tymon, 2017; Johnson & Peifer, 2017; Jones et al., 2013) found evidence of decreasing confidence in university graduates, though varies according different social contexts. Hunsaker & Thomas (2014) contend that confidence in higher education is diminishing, which commands sweeping changes in the higher education system.

Method

Design

The study is a between-groups design involving two groups of participants (a graduate and a non-graduate group) who were selected from a residential weekend school to experience the same conditions, i.e. perform a numerical test. The independent variable was the level of qualification (graduate vs. non-graduate). The participants were administered a two-part basic mathematical test consisting of simple multiplications. The questions in the first part had one digit numbers to be multiplied with a two-digit number; the second part operations comprised two-digit numbers to be multiplied by other two –digit numbers. It was assumed that operations in the second part of the test would be harder than those of the first part. The dependent variables were the rating of Confidence (expressed using the scale 50 - 100), percentage of right answers and Average of Correct Answers. The basic design did not set a specific time limit for participants to attend to the stimuli but they were strongly encouraged to respond to stimuli within 20 seconds). Responses that participants provided to each stimulus were at two levels: (1) answer TRUE/FALSE to suggest estimates to multiplication operations (2) estimate

level of confidence about their answer. For instance, a stimulus like $22 \times 31 = 650$ TRUE–FALSE; then (confidence = 70%). The E-prime software was used to record participants' response time and correct answers.

Participants

The study participants were recruited from a group of part-time student managers attending a residential weekend. The sample included all the participants of the residential weekend. The participants had similar educational experience in that they all attended higher education in the UK. All the participants were from social science (including business studies) and humanities backgrounds. We therefore assumed that they did not have the expert mathematical backgrounds of graduates of numerate subjects (e.g. engineering, mathematics and science, etc.) would have. A participant group comprised eleven residential weekend students who were graduate managers in various companies. The second group of participants comprised eleven respondents who also attended higher education but those did not have a university degree - they had other lower qualifications such higher national certificates (HNC) or levels 4 and 5 of the national vocational qualifications (NVQ). The participants had completed their higher education/vocational qualifications and had been working as managers for between 2 and 5 years. They were then pursuing a part-time masters programme which had a compulsory residential weekend. The groups were equal in number so as to enable reasonable comparisons. The respondents were fully briefed about the level of difficulties of the test and shown a sample of the numeracy test. The participants were in different rooms and could not talk to one another.

Apparatus

The experiment, conducted using E-prime which allowed to record participants' correct answers as well as response times for the purpose of comparisons between the two groups. Major analysis areas were Overall confidence estimates of the participants' number skills abilities; Overall estimates of time taken to complete test; accurate/inaccurate answers per group; comparison

between graduates and non-graduates and a two-way ANOVA. The results were plotted on a graph to make significance more visible. Descriptive statistics like averages, percentages, means, mode, significance, etc. were considered for data description and support comparative frameworks.

Procedure

Four introductory questions ask the participants their overall confidence with numbers (between 50 - 100), qualification, age, gender; the last question asks the participants to state the amount of time taken for the task. The main questionnaire's set as multiplication operations whose values are estimated alongside participants' confidence level about answers to the estimated value of multiplications. The test comprised 40 questions or stimuli each with question about estimate confidence level. The first part of the test comprised multiplications with one digit on one side and double digit on the other; the second comprised double digits on either side, e.g. $6 \times 79 = \dots$, $22 \times 31 = \dots$. The participants were thoroughly briefed for consent and were given the opportunity to withdraw at any time. Answers were anonymous to preserve confidentiality. Participants were asked not to use calculators and to provide estimates from memory. Estimates deemed correct were within 10 per cent from the actual of the multiplication. It was anticipated after piloting the questionnaire that the experiment would take 6-10 minutes, giving participants approximately 20 seconds per question.

Results

A between-subject ANOVA test was performed. The output supports the hypothesis that graduates overestimate their numerical skills confidence as a result of higher qualification levels. The significance level of the interaction term is $p = 0.305$, d.f. = 1 for Overall Confidence and $p = 0.542$, d.f. = 1 for Number of correct answers, which are well above 0.05. In this section, only significant aspects and graphs from ANOVA are examined. Table 1 summarises the main results, contrasting independent variable (Qualification, Age, Gender) with four

dependent variables (Overall Confidence rating, Number of Correct Answers, No. Incorrect Answers and Time Taken).

TABLE 1 HERE...

Overall graduates estimated their overall confidence in numerical skills lower than non-graduates. Younger graduates under 25 (age category 1) estimated their level of confidence above 90% while older graduates (age category 3 blue) averaged their confidence level (mean = 71.5%). This compares less favourably with non-graduates who were more confident about overall numerical skills confidence (Mean = 74.6%). However, the non-graduates actual results (test scores) were consistent with their expressed level of confidence and the test scores for graduates did not match their expressed level of confidence, thus suggesting overconfidence among graduates (hypothesis c).

GRAPH 1 HERE ...

With number of correct answers (NrCorrA), non-graduates fared much better than their graduate rivals. Non-graduates achieved overall a minimum of 22/40 and a maximum of 28/40 right answers (Mean = 25). This compares highly to graduates who achieved 20/40 and 25/40 respectively (Mean = 23). When the age factor is taken into account, Graph 2 shows that older participants in both qualification groups achieved much higher rate of correct answers compared to the younger participants. Typically, the higher ranges above were achieved by older participants, with older non-graduates outperforming older graduates (average 29 correct answers – versus - average 25 correct answers).

GRAPH 2 HERE ...

In average expressed confidence rating per question, graduates rated their confidence level lower, ranging from 70 - 100 per cent (Mean = 85). Again, non-graduates were more confident with their confidence rating, ranging from 75 - 97 per cent (Mean = 87). Younger graduates were more boastful about their confidence per question, often indicating ratings of 100%. But in contrast, older non-graduates rated their confident level higher than the younger non-graduates (97 for over 40 year-olds compared to 77 for 25 - 40 year-olds) - See Graph 3.

GRAPH 3 HERE ...

A more significant level of contrast is observed when results are interpreted in terms of time taken. Graduates, unexpectedly, spent considerably more time than non-graduates. Graduates spent a minimum average of 14.5 minutes, with a maximum average of 18.5 minutes. Non-graduates took only on average 10.5 minutes and a maximum of 14.1 minutes to complete the task. When the age factor is applied, there appears another significant contrast: younger graduates (age group 1), who earlier expressed a higher confidence in their numerical skills, spent the longest (17 minutes maximum) to complete the task - See Graph 4.

GRAPH 4 HERE ...

Discussion

The research started by hypothesising that: (1) graduates are more likely than non-graduates to over-rate basic mathematical skills; (2) graduates' real basic mathematical skills can be lower than their skill estimates; (3) in a basic number test, graduates' performance is not higher than non-graduates'. The general impression emerging from the data is that graduates' performance in the experiment task was lower than non-graduates'; and generally graduates'

performance was not commensurate with their estimate of numerical skills. These results support all the research hypotheses.

In this experiment, graduates estimated their numerical capabilities almost 20% higher than their test performance (confidence estimate = 71.5% compared with average achievement in test of just 57.5%). The results therefore show overconfidence in number skills. Overconfidence here is based on Christensen-Szelanski & Bushyhead's (1981) theorisation, which asserted that in reality people do not know as much as they claim to. This is also evident in Malmendier & Tate's (2015) study of overconfidence in forecasting among CEOs. When presented with two elements of choice and asked to evaluate themselves in terms of certainty about answers, people rate their level of confidence higher than their actual abilities (Gigerenzer, Hoffrage & Kleinbolting (1991). In the context of our experiment, Gigerenzer, Hoffrage & Kleinbolting's (1991) theory also supported the finding for non-graduates, though to a lesser extent than it supported graduates'. With these slightly different results, one can argue that, while Gigerenzer, Hoffrage & Kleinbolting's (1991) framework could form an interesting starting point for overconfidence study, but it cannot be an axiomatic prescription.

Though this is not apparent from the ANOVA test, because it has not been the focus of this test, manual analysis of the results shows that most wrong answers for graduates and non-graduates came in the latter part of the test (multiplication operations with double digits on either side). These multiplications were harder and attracted lower confidence ratings on the 50 - 100 scale. If this is confirmed in a separate ANOVA test, then, it would be plausible to argue that the findings also support Brunswik's (1955) Hard-Easy theory. Brunswik argues that overconfidence is lower as the questions to be answered become harder; in other terms, people become more objective about the assessment of their capabilities when the questions that they are asked to answer become harder. In a similar assessment, Sieck & Arkes (2005) investigating managerial decision-making, found that managers tended to be more complacent in decisions relating to routine matters as opposed to decisions about novel ones.

The fact that graduates were overconfident could signify that graduates use the graduate status to legitimise and overrate their abilities. Similarly, Sieck & Arkes believed that more attention ought to be paid to the development of managers vis-à-vis routine decision-making, we can also put that despite graduate status, managers cannot be exempted from numeracy and literacy development programmes in work settings or educational environments. Bullough, Renko & Myatt (2013) found that the development of managers at all times provides the opportunity for growing resilience and a greater entrepreneurial spirit.

Conclusion

In summary, the results demonstrate that as predicted graduates show overconfidence in numerical skills; in line with previous studies, undergraduates rate themselves considerably higher than their industry counterparts (Jackson, 2012). The findings confirm Harvey's (1997) view that people make judgements based on their assessment of themselves, with possible subjectivity. Both graduates and non-graduates showed over confidence but the degree of overconfidence for graduates was higher than that of non-graduates. Being a graduate may lead people to overstate their numerical abilities than not being a graduate. The findings support our hypotheses and Gigerenzer, Hoffrage & Kleinbolting's (1991) overconfidence theory proving that generally people pretend to know more than they actually do. Should a bigger study confirm these results, it will support parts of the employer's claim that graduates overstate their basic skills competence. The findings have critical implications for higher education institutions and learning and development managers in organisations. Not only do the findings emphasise the critical importance of development in organisations (Harrison, 2011) but they also call for a degree of caution when addressing the learning and development needs of students in higher education and the professional development of employees. The results indicate that there is a need for equal emphasis on graduate and non-graduate manager training in organisations. The assumption that the graduate managers' higher level of qualification could exempt them from basic

professional development activities has been rejected by the findings of the research. Learning and development provision requires democratisation in order to grow a more productive workforce. However, the stated issues with this experiment mean that results should be taken with caution. Further research in the field would enable the formulation of more authoritative conclusions (Karadağ, 2017).

Greater attention is required towards increasing the quality (in terms of better and more relevant skills) to stimulate demand for graduates in the wider economy (Copley, 2013; Escudeiro and Escudeiro, 2012; Okunuga and Ajeyalemi, 2018). These competencies are not usually addressed in curricula (Escudeiro, and Escudeiro, 2012). In this regard, the role of Universities in developing softer skills becomes crucial towards graduates employability (Evans, Gbadamosi, Wells, and Scott, 2012; Jackson, 2012; Mattern, 2016).

Given the evidence of this research and survey finding by Kuczera, Field & Windisch (2016) exposing lower levels of numeracy among British graduates, we propose that higher education curricula make room for the teaching of numeracy by embedding it into the curriculum throughout. Though some academics disagree with the implementation of the skills-agenda in universities (Holmes, 2013), in the UK, like many developed nations, the employability agenda is driven by the government and universities comply with government requirements as enhanced funding may be contingent upon the HEIs' employability records. In addition, various ranking frameworks take into account employability data. Thus, employer input in curriculum design will enhance higher education's ability to fill this skill gap (Jones et al., 2017; Mason, Williams & Cranmer, 2009; Purcell, 2008). It is equally important that organisations consider sharpening the numeracy level of their graduate employees through systematic training programmes in the early period following hiring. Such early engagement with training needs could prepare their graduate workforce in routine and complex decision-making (Bullough, Renko & Myatt, 2013; Sieck & Arkes, 2005), particularly in the management of projects, forecasting and the management of change. Jones et al. (2017) suggests that higher education

institutions must evaluate their provision in terms of employability to ensure it evolves with dynamic workplace requirements.

Study Limitations and Future research

This study represents an initial investigation into overconfidence in a number of skills among graduates and non-graduates. As such graduate and a non-graduate group were selected from the residential weekend programme. We recognize the need for further study to address limitations in this research. Future research may consider a wider sample from diverse disciplines. In addition, future studies could examine implications of overconfidence among learners (young vs. mature studies or male vs. female students at the university level but at different stages in a degree programme. A larger sample of respondents from a more geographically diverse background would allow for a closer statistical analysis of emergent themes (Pearl et al. 2019). We believe that these further studies will strengthen the findings from this study. The experiment produced some interesting results that largely supported the hypotheses. However, weaknesses need highlighting.

In addition, more complex statistical analysis of the test results would enhance the the results and create a more accurate picture of graduate overconfidence in order to establish targeted remedial actions.

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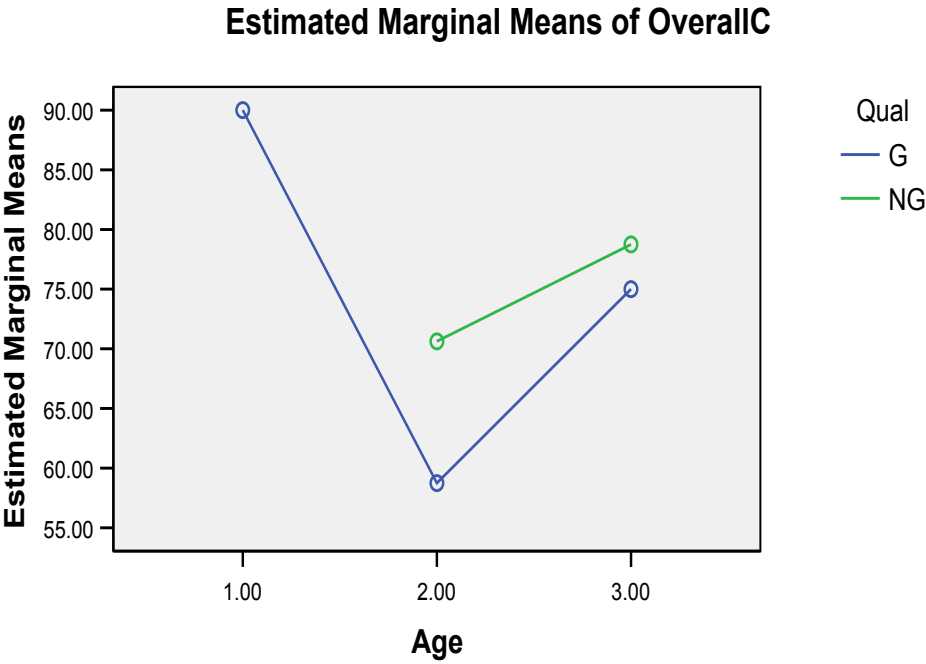
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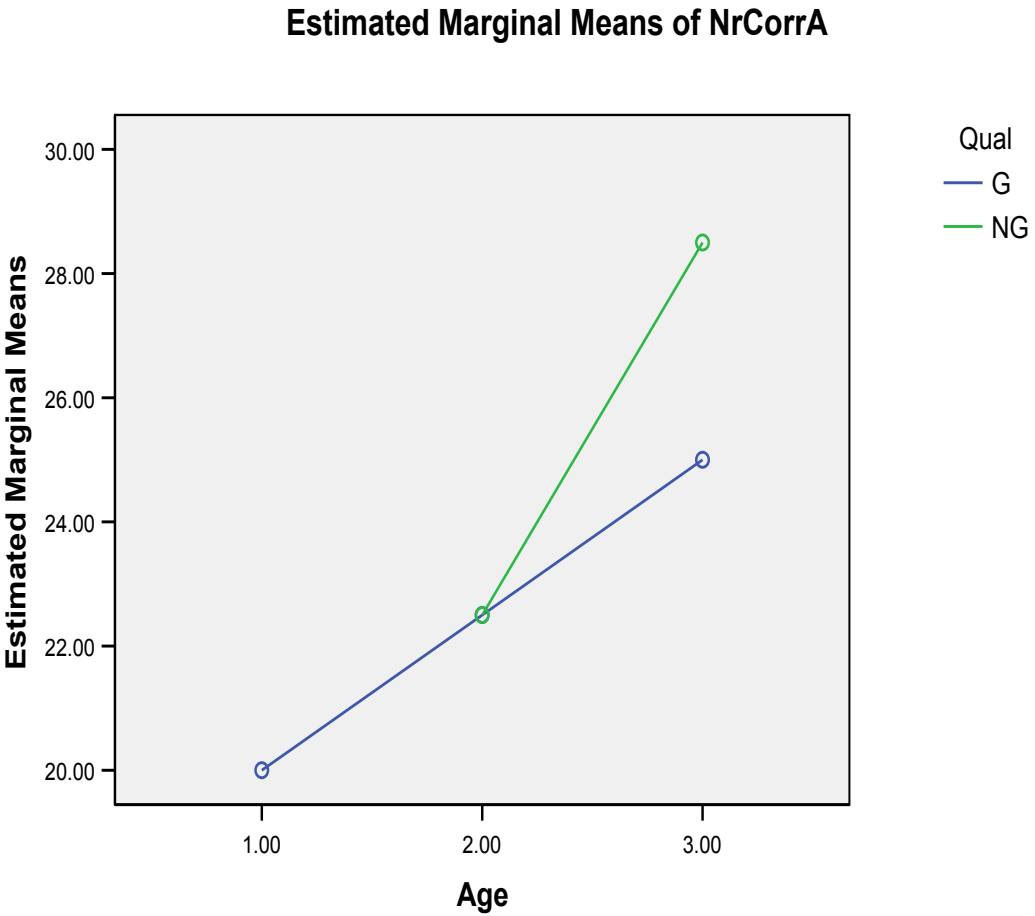
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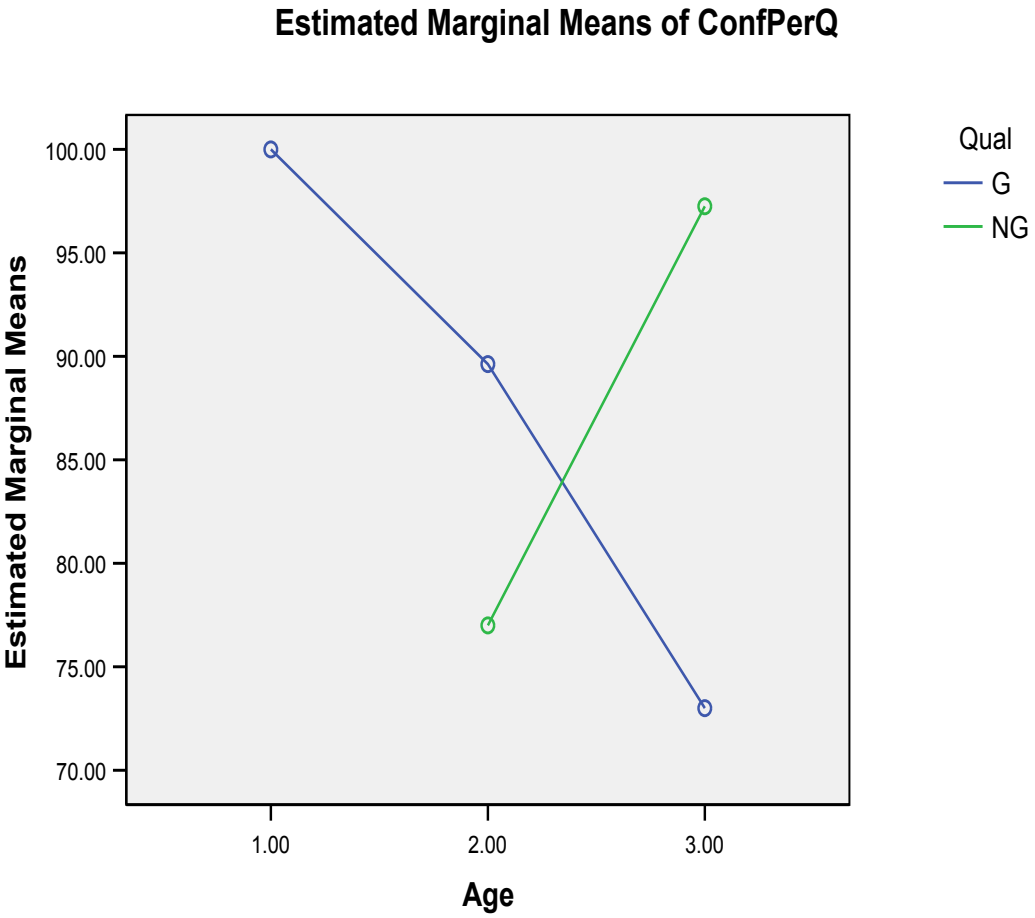
Non-estimable means are not plotted

Graph 1 Overall confidence expressed by level of qualification



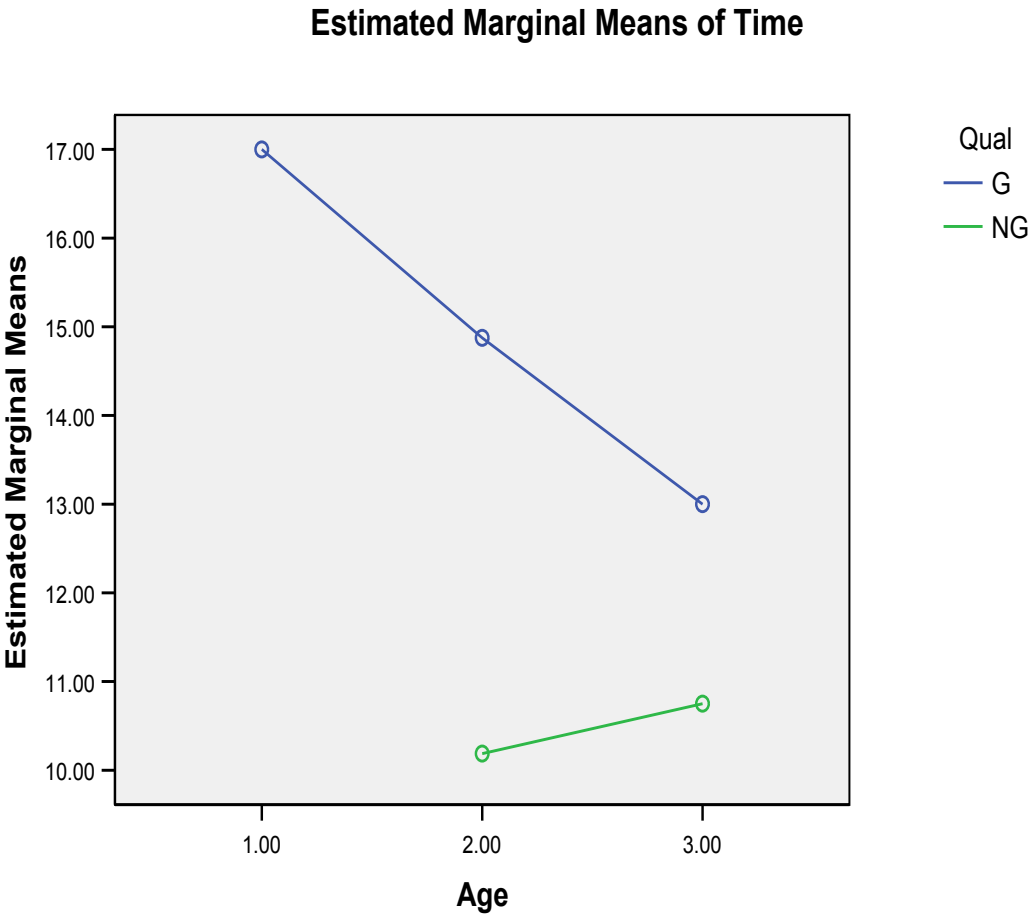
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Graph 2 Number of correct answers by level of qualification and age



Non-estimable means are not plotted

Graph 3 Individuals' estimate of confidence per question



Non-estimable means are not plotted

Graph 4 Time taken by each qualification group to complete the test

Number test - PART 1

A. $2 \times 89 =$

Confidence level:

B. $6 \times 79 =$

Confidence level:

C. $8 \times 21 =$

Confidence level:

D. $3 \times 44 =$

Confidence level:

E. $5 \times 27 =$

Confidence level:

F. $7 \times 19 =$

Confidence level:

G. $7 \times 36 =$

Confidence level:

H. $9 \times 18 =$

Confidence level:

I. $4 \times 53 =$

Confidence level:

J. $6 \times 65 =$

Confidence level:

K. $8 \times 19 =$

Confidence level:

L. $2 \times 76 =$

Confidence level:

M. $3 \times 49 =$

Confidence level:

N. $5 \times 23 =$

Confidence level:

O. $4 \times 76 =$

Confidence level:

P. $4 \times 94 =$

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- Confidence level:
- Q. $3 \times 52 =$
- Confidence level:
- R. $7 \times 77 =$
- Confidence level:
- S. $5 \times 24 =$
- Confidence level:
- T. $8 \times 13 =$
- Confidence level:

Test 2 appears on a separate page.

Number test - PART 2

- AA. $22 \times 31 =$
- Confidence level:
- BB. $21 \times 25 =$
- Confidence level:
- CC. $12 \times 32 =$
- Confidence level:
- DD. $16 \times 17 =$
- Confidence level:
- EE. $23 \times 14 =$
- Confidence level:
- FF. $19 \times 19 =$
- Confidence level:
- GG. $13 \times 18 =$
- Confidence level:
- HH. $15 \times 18 =$
- Confidence level:
- II. $17 \times 23 =$
- Confidence level:
- JJ. $16 \times 21 =$

Confidence level:

KK. $18 \times 12 =$

Confidence level:

LL. $25 \times 12 =$

Confidence level:

MM. $23 \times 14 =$

Confidence level:

NN. $24 \times 16 =$

Confidence level:

OO. $26 \times 12 =$

Confidence level:

PP. $27 \times 13 =$

Confidence level:

QQ. $28 \times 17 =$

Confidence level:

RR. $29 \times 12 =$

Confidence level:

SS. $15 \times 19 =$

Confidence level:

TT. $11 \times 27 =$

Confidence level:

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Dependent Variable	Qual	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
OverallC	G	71.500(a)	5.138	60.401	82.599
	NG	74.688(a)	4.834	64.244	85.131
NrCorrA	G	23.000(a)	1.877	18.944	27.056
	NG	25.500(a)	1.767	21.683	29.317
NrIncorA	G	17.500(a)	2.123	12.914	22.086
	NG	14.500(a)	1.997	10.185	18.815
ConfPerQ	G	85.050(a)	4.528	75.267	94.833
	NG	87.125(a)	4.261	77.919	96.331
Time	G	14.550(a)	1.809	10.642	18.458
	NG	10.469(a)	1.702	6.791	14.146

(a) Based on modified population marginal mean

Table 1 Qualification*dependent variables